

No. 7, June 2012

## Features

### President Yoshiyuki Sakaki outlines plans for his second term

Dr Yoshiyuki Sakaki was reappointed the president of Toyohashi University of Technology in April 2012. "During this shorter, two year term, I want to strengthen and complete the initiatives I started during my previous four year tenure," says Sakaki. "The three main pillars of the university are education, research and our contribution to both the local and global society. I want to maintain a balanced approach in all three of these areas to create an environment to nurture leaders, specialists, and leaders able to play an active role on a global level."

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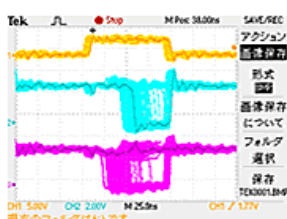
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## News

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## Features

### President Yoshiyuki Sakaki outlines plans for his second term

Dr Yoshiyuki Sakaki was reappointed the president of Toyohashi University of Technology in April 2012. "During this shorter, two year term, I want to strengthen and complete the initiatives I started during my previous four year tenure," says Sakaki. "The three main pillars of the university are education, research and our contribution to both the local and global society. I want to maintain a balanced approach in all three of these areas to create an environment to nurture leaders, specialists, and leaders able to play an active role on a global level."

Under president Sakaki's leadership Toyohashi University of Technology (Toyohashi Tech) restructured its undergraduate education courses into five new departments:

Mechanical Engineering  
Electrical and Electronic Information Engineering  
Computer Science and Engineering  
Environmental and Life Sciences  
Architecture and Civil Engineering

"The inclusion of more courses related to the environment and life sciences reflects the needs of industry and society in general of the 21<sup>st</sup> century," says Sakaki. "We want to offer students a much more diverse range of subjects to study."

In addition to restructuring educational courses, president Sakaki has also launched innovative research initiatives exemplified by the Electronics-Inspired Interdisciplinary Research Institute (EIIRIS: <http://www.eiiris.tut.ac.jp/index.html>). "The role of EIIRIS and other research initiatives at the university is to contribute to solving global problems such as food production, aging societies, and disaster mitigation and management," explains Sakaki. "I think that an interdisciplinary approach is crucial to find solutions to these daunting problems."

EIIRIS forms the hub of new international young researcher exchange programs. Examples of recent exchange agreements include the launch of researcher-based exchange programs with Indian Institute of Technology, Delhi; University College London; Davy-Faraday Laboratory, at the Royal Institution of Great Britain; University of California, Irvine; Pierre et Marie Curie University - (PARIS 6); and Chungnam National University (Korea).

"EIIRIS shows our emphasis on an international approach to collaborative research," says Sakaki. "We are also organizing international conferences and symposia to encourage international collaboration and to increase the visibility of the activities of the university".

Other recent initiatives include the Center for Human-Robot Symbiosis Research and the Research Center for collaborative Area Risk Management.

The Irago Conference (<http://www.apirc.jp/>; also known as the Asia Pacific Interdisciplinary Research Conference (AP-IRC)) is an example of one of the outreach initiatives launched by Sakaki. The AP-IRC 2011 held Nov 17-18, 2011 (<http://www.apirc.jp/apirc2011/index.html>) attracted over 400 participants and yielded 50 refereed papers that were published in the IOP JPCS (<http://iopscience.iop.org/1742-6596/352/1>).

Other program being implemented at Toyohashi Tech include: Tailor Made Baton Zone: <http://www.batonzone.tut.ac.jp/> for graduate student; Sakaki Prestige Lectures: <http://www.tut.ac.jp/prestige-lectures.html>, by internationally renowned scholars and industrialists for the general public; and EIIRIS Special Seminars for the general public <http://www.eiiris.tut.ac.jp/index.html>.

"Managing the university is one of my main roles," says Sakaki. "But in addition to this, I would like to think that my most important mission as president is to inspire faculty, administration, and of course students to tackle the many challenges facing mankind of the 21<sup>st</sup> century".



No. 7, June 2012

## News

### Indonesian Students Visit Toyohashi Tech under the Japan-East Asia Network of Exchange for Students and Youths Programme



Indonesian students visit Japan

On May 11, Toyohashi University of Technology hosted 21 students and one faculty member from Indonesia under the Japan-East Asia Network of Exchange for Students and Youths (JENESYS programme).

After being greeted to the university by Kiyokatsu Jinno, Vice President in charge of Educational and International Affairs, the students attended a lecture by Prof. Akira Mizuno of the Department of Environmental and Life Sciences. Following this, Indonesian students enrolled at Toyohashi Tech gave the visitors a presentation on the university, providing a general overview as well as information on student life and our research activities, followed by an exchange of opinions.

The group then toured the Electronics-Inspired Interdisciplinary Research Institute (EIIRIS) and the Research Center for Agrotechnology and Biotechnology. The Indonesian students listened intently and asked many questions throughout their tour. They enjoyed interacting with their Japanese counterparts, including demonstrations by the Japanese Martial Arts Club and trying their hand at calligraphy with the International Exchange Club.



Tour of the Research Center for Agrotechnology and Biotechnology



Efforts at calligraphy

## Toyohashi Tech Welcoming Party for New International Students

In April 2012, the new academic year started at Toyohashi Tech with the university accepting total of 37 international students from ten countries, including Malaysia, Indonesia, Vietnam, China, Tanzania, Mongolia, Laos, Sri Lanka, Korea, and Bosnia-Herzegovina. 10% of the students enrolled at Toyohashi Tech are from overseas.

On April 4<sup>th</sup>, President Yoshiyuki Sakaki, Executive Trustee, Vice President Kiyokatsu Jinno and faculty members joined at a welcoming party held for international students.

In his welcoming speech President Sakaki extended his welcome to all the international students. "Over the past several years, many overseas students have graduated from Toyohashi Tech and have become active in their careers worldwide," explained Sakaki. "Please become globally active by studying and conducting research our university. Furthermore, please deepen your interaction with Japanese students and thereby contribute to the globalization of the university."

In a warm and friendly atmosphere, the international and Japanese students exchanged pleasant conversation while enjoying party dishes. Some students wore ethnic costumes.

Toyohashi Tech is scheduled to accept further international students in October 2012.



Welcoming party



Newly enrolled students from Malaysia

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## Research highlights



Digital generation of true random numbers for computer security



Monitoring health of milk cows



Gallium nitride ultraviolet detector with integrated silicon amplifier

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## Research highlights

### Digital generation of true random numbers for computer security

The generation of true sets of random numbers is critical for secure computer system networks. True random number generation (TRNG) is carried out by analog electron circuits, which are expensive and difficult to integrate with digital technology.

Here, Hisashi Hata and Shuichi Ichikawa describe the design and implementation of TRNG from fully digital circuits by exploiting the metastability of the RS latch.

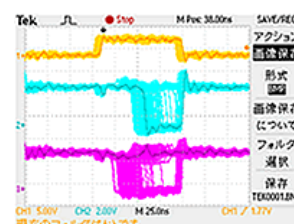
The TRNG is comprised of only logic gates enabling ease of integration with logic LSI. Notably, the RS latch is implemented as a 'hard macro' to ensure randomness by minimizing signal skew and load imbalance of internal nodes.

The TRNG has 256 latches, occupies 580 slices, and achieves 12.5 Mbps output.

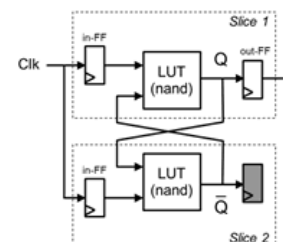
- Hisashi Hata and Shuichi Ichikawa
- FPGA Implementation of metastable-based true random number generation
- IEICE Trans. Inf. & Syst. **E95-D**, 426–436, (2012)



Shuichi Ichikawa



Observed metastability of an RS latch



LUT latch: an RS latch, implemented with two LUTs in FPGA device



Practical configuration of a TRNG



## Research highlights

### Monitoring health of milk cows

The mass production of high quality milk necessitates routine monitoring of the health of dairy cows. In particular, monitoring the pH, electrical conductivity, and temperature of the rumen would enable precise control of the feeding system to optimize the stomach conditions.

Here, Masato Futagawa and colleagues at Toyohashi University of Technology describe a wireless multimodal sensor system for measuring the electrical conductivity and temperature of the stomach of a dairy cow.

The electrical conductivity (EC) and temperature sensor were integrated on the same chip using silicon CMOS technology. Specifically, the electrical conductivity was determined by the resistance between two Pt electrodes, and the temperature by analysis of the current-voltage characteristics of a p-n junction diode.

Real time measurements were made by constructing a wireless system consisting of sensors, battery, antenna, analog signal-processing circuit board, AC-to-DC converter board, and receiver-transmitter board.

The system was used to measure EC (0.4~0.7 (S/m)) and temperature (32 – 39 °C ) before, during and after feeding the cow.

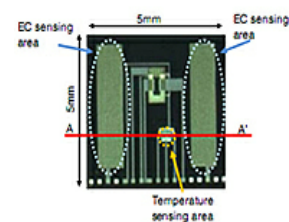
This technology is also being used to monitor the growth of agricultural products including tomatoes.

#### Reference

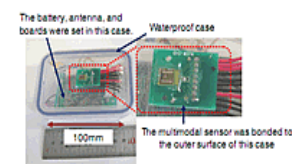
Masato Futagawa, Taichi Iwasaki, Mitsuyoshi Ishida, Keita Kamado, Makoto Ishida, and Kazuaki Sawada  
A Real-Time Monitoring System Using a Multimodal Sensor with an Electrical Conductivity Sensor and a Temperature Sensor for Cow Health Control  
Jpn. J. Appl. Phys. 49, 04DL12, (2010).



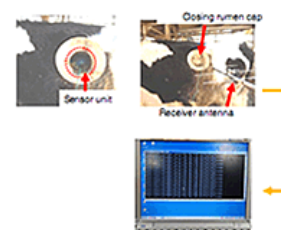
Masato Futagawa



EC and temperature sensors on the same silicon chip



Actual components of the multi-modal sensor system



Real time measurements of the rumen of a cow

## Research highlights

### Gallium nitride ultraviolet detector with integrated silicon amplifier

Gallium nitride (GaN) and related materials are extensively used for the fabrication of blue LEDs and lasers. In addition to such light emitting devices, the ability to vary the band gap of gallium nitride compounds over a wide energy range offers potential for the fabrication of ultraviolet (UV) detectors for applications such as flame and heat sensors and medical imaging. Gallium nitride UV detectors may replace conventional photomultiplier and silicon detectors.

However, current GaN based UV detectors necessitate connection of external transistor circuits to amplify the otherwise weak signal from the UV detector.

Here ChangYong Lee and colleagues at Toyohashi University of Technology describe the realization of GaN Schottky diode UV detectors with integrated silicon-charge transfer type signal processors, thereby eliminating the requirement to-date for attaching external transistor circuits to amplify the weak signal from the GaN UV detector.

The UV sensor consisting of a Au-GaN photodiode and n-MOS signal processor was produced by a MOS/PD seamless process. The key stages of the fabrication process are wafer bonding the GaN-based PD to the MOS signal processor by metal contacting; isolation of the PD by reactive ion etching; gate electrode patterning; deposition of passivation layer; and electrode formation.

More specifically, the 10-nm-thick Au semitransparent Schottky contact exhibited the sensitivity of 26.3mAW at 296 nm for 12 $\mu$ W/mm<sup>2</sup> UV irradiation power. The main feature of this UV detector is the extremely wide sensitivity range that can be achieved by changing the number of integration cycles at the silicon-charge transfer circuit. The authors estimate that the detector can detect weak UV signal of 10pW/mm<sup>2</sup> from flames, and the GaN and Si heterogeneous detector could also be utilized for new type of flame sensor by high-resolution image capturing

#### Reference

Intelligent Ultraviolet Sensor Composed of GaN-Based Photodiode and N-Channel Metal Oxide Semiconductor Si-Charge Transfer Type Signal Processor  
Japanese Journal of Applied Physics 51 , 044101, (2012).

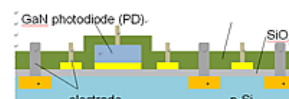
Chang Yong Lee, Fumiya Matsuno, Yoshinori Hashimoto, Hiroshi Okada<sup>1</sup>, Kazuaki Sawada, and Akihiro Wakahara

Affiliations: Department of Electrical and Electronic Information Engineering, Toyohashi University of Technology, Toyohashi, Aichi 441-8580, Japan

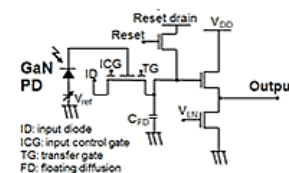
<sup>1</sup>Electronics-Inspired Interdisciplinary Research Institute (EIIRIS), Toyohashi University of Technology, Toyohashi, Aichi 441-8580, Japan



Akihiro Wakahara



Concept of intelligent ultraviolet (UV) sensor composed of GaN-based photodiode and Si n-MOS signal processor



Circuit diagram of intelligent UV sensor



## Club Activities

### Scale modeling club

If you think plastic scale model making is child's play, you haven't seen how seriously members of the Toyohashi Tech Mokei Club (Scale Modeling Club) take their hobby of customizing their models.

Some 15 members gather twice a week for up to four hours a time in the evenings to assemble and refine their models. "Members are free to make any design of model," says Atsuya Wada, a third-year mechanical engineering student and the leader of the club. "But the most popular choices are the various models of Gundam."

As fans of Japanese popular culture know, Gundam is the generic name for giant fighting robots featured in a series of television 'anime'. Notably, the success of the television programs spawned Gundam inspired video games, comics, movies and even a theme park. Other popular model choices follow a military themes including tanks and airplanes.

Wada shows off his customized Gundam model and points out how he has carefully filled the seams between parts with glue and sand-papered them down to give them the same texture as the surrounding plastic. He has also painted on his own designs and provided the robot with weapons he assembled separately.

Yu Miyazaki, the previous club leader and now a first-year master's student at the department of mechanical engineering, describes some of the tools and materials used in assembling the models. Serious modelers use small side cutters to remove the plastic spurs left after detaching the 200 or 300 parts from plastic part holders. Glues, for instance, come in different viscosities with different drying times. Then there are different types of sandpaper employed for smoothing out rough parts, edges, excess glue, and so on.

"Some members also make their own original models from scratch," says Miyazaki. "To work the plastic materials, they use special cutting tools with different detachable heads, measuring cutting boards and hand drills that come with a choice of drill-bit sizes." It's quite a challenge, he says, "to make your own model to your own design, but there is great satisfaction to see it completed."

Wada explains that they do not hold contests, but instead "Show and Tell" events amongst themselves for feedback and opinions. This helps other members learn about techniques and get advice about problems they may encounter in implementing them. "We also display our models at the university festival," he adds, "and show them to freshman to attract new members."



**Members of the Toyohashi Tech Mokei Club**

Atsuya Wada (Club leader 2<sup>nd</sup> from right)  
Yu Miyazaki (previous leader third from right)

No. 7, June 2012

## Excursions

### Our first ever visit to Tokyo

Mr Chandra Prakash and Ms Gauri N. Patwardhan are serving an internship at Electronics-Inspired Interdisciplinary Research Institute (EIIRIS).

We are 4<sup>th</sup> year undergraduate students from Indian Institute of Technology, Delhi who were awarded the EIIRIS Internship at Toyohashi Tech. Under the guidance of Professors Makoto Ishida and Adarsh Sandhu, of EIIRIS, we are both studying the synthesis and physical properties of graphene—the magic single layer of carbon that spawned the Nobel Prize in Physics in 2010.

We have enjoyed our stay in Toyohashi ever since the first day we landed at Nagoya Airport on May 15th. The tranquillity, green surroundings, and wide open skies at Toyohashi very refreshing. It's our first visit to Japan, and we have found that although Japanese people sometimes look slightly serious, in reality they are very friendly, polite, kind, and a pleasure to meet.

Last week we made our first trip outside Toyohashi: we visited Tokyo. One of the most dynamic and costliest cities in the world. One of our childhood dreams became a reality!

Our trip started with a ride on the bullet train or *Shinkansen*. It was too quick to even take a nap and we arrived at Shinagawa Station in Tokyo in about 80 minutes. We first visited one of Professor Sandhu's students at Tokyo Institute of Technology. Its museum and the 'cheesecake' library were amazing!

In the afternoon we visited the beautiful Meiji Shrine, where in spite of the rain, the trees and historic wooden structures produced a very soothing atmosphere. To our surprise, we found that some of the architecture of the buildings was simpler to that of such structures in India. We have learnt that shrines in Japan have big 'toris' at their entrances, which intriguingly is also a signature of the Buddhist architecture prevalent in India.

After Meiji Shrine we walked around some of the modern parts of Tokyo including Tokyo Tower near Roppongi, which reminded us of parts of Paris.

The next day we decided to have a ride on the jet-coasters at Fujiyuku Highland amusement park on the outskirts of Tokyo. Our hearts nearly popped out of our mouths at the first steep fall of the 'Fujiyama' roller coaster. Believe us, we have experienced a lot of roller-coasters, but this one was really scary! We saw Mt. Fuji too.

That evening we returned to Tokyo and went to the Odaiba beach area. Our walks around Tokyo led us to think that Japan has some excellent replicas of internationally recognizable icons, such as Tokyo Tower that resembles the Eiffel Tower and the Statue of Liberty in Odaiba. We look forward to seeing a replica of the Taj Mahal!

Next morning, we visited the Asakusa area and took photographs near the the sensational 'Sky Tree' really is an engineering marvel. We also walked around Senso-ji Temple, where ambience resembled Indian pilgrim centres. The market around the temple was an excellent place to buy traditional Japanese souvenirs.

Finally, we went to 'Akihabara' the Okatsu's hub of Tokyo. Apart from the anime-market, every electronic gadget we could think of was on sale. We also scanned for the café-maids. After shopping at Akihabara, we took the last Shinkansen to Toyohashi and bid goodbye to the city of sky-scrapers.

In a nut-shell, we loved Tokyo. We have been to Paris too. Both seemed to be equally lively, Paris seemed to be more cultural, but in terms infrastructure and the use of technology, Tokyo is really better and far more complex.

Finally, we would like to thank Toyohashi Tech, and EIIRIS in particular for giving us this opportunity to conduct research here, and see the sights of this fascinating country.



Mr Chandra Prakash at the entrance to Meiji Shrine



Ms Gauri N. Patwardhan at Odaiba in front of Tokyo beach



In front of the Sky Tree in Tokyo